

Department of Civil and Geological Engineering
GEO E 475.3: Advanced Hydrogeology
MIDTERM EXAMINATION

Time Allowed: 1 hour
Instructor: Dr. M. J. Reeves

27 October 2006

SECTION A

(Multiple-choice 3 marks each - spend up to 10 minutes - PLEASE USE ANSWER BOOK)

1. In the hydrologic cycle, which of the following approximate balances is closest to being true?
 - a. precipitation = evaporation - runoff
 - b. precipitation = runoff - evaporation
 - c. precipitation = evaporation + runoff
 - d. precipitation = evaporation x runoff
 - e. precipitation = evaporation / runoff
2. Which of these statements about human activities and the hydrologic cycle is false?
 - a. Building roads and parking lots increases the amount of infiltration. $\leftarrow F$
 - b. Use of irrigation waters in dry areas increases the amount of evaporation. \uparrow
 - c. Human contributions to global and local warming can change the balance of water in different hydrologic reservoirs. \uparrow
 - d. Runoff patterns are altered when water is diverted from one region to another.
 - e. Uranium mineralization is controlled by the movement of groundwater.
3. Which of the following statements about the water table is true?
 - a. \uparrow The water table changes when discharge is balanced by recharge.
 - b. \odot The water table has the same general shape as the topography.
 - c. \uparrow The water table is deep below the land surface beneath lakes.
 - d. \uparrow The water table is elevated near high volume pumping wells.
 - e. The water table fluctuates with changes in atmospheric pressure.
4. Darcy's Law states that the volume of water flowing through a unit cross-sectional area per unit time is equal to _____.
 - a. porosity x hydraulic conductivity
 - b. porosity x hydraulic gradient
 - c. \odot hydraulic conductivity x hydraulic gradient
 - d. hydraulic conductivity x hydraulic gradient x porosity
 - e. hydraulic conductivity x hydraulic gradient / porosity

$$Q = -K_i A$$

$\frac{Q}{A} = -K_i$

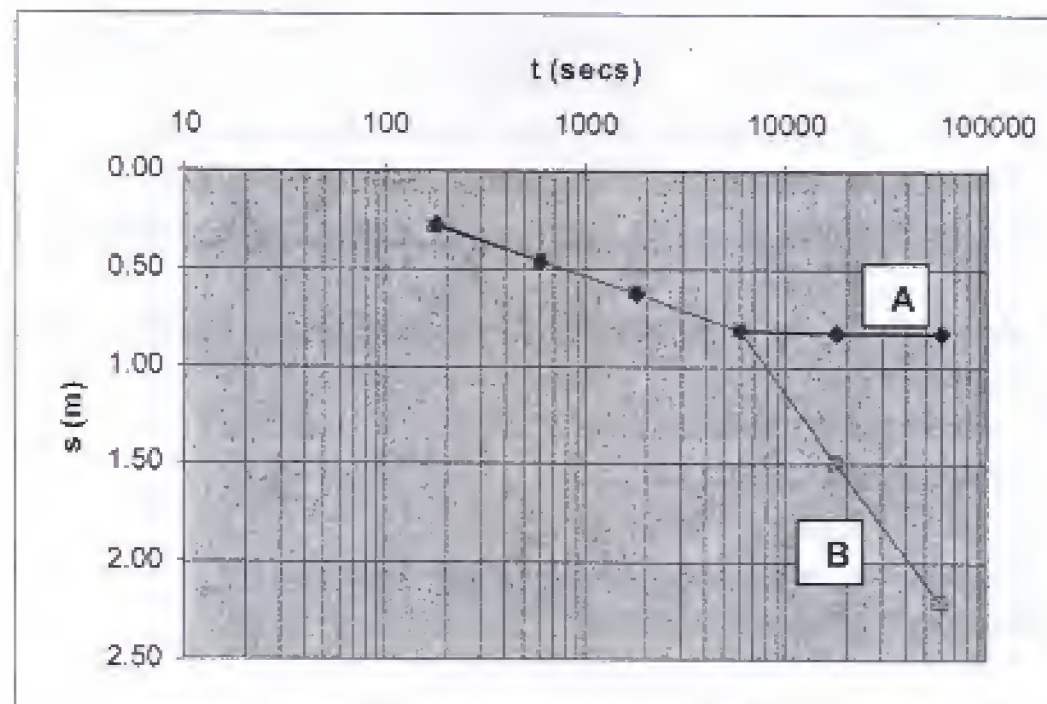
$\frac{Q}{A} = -K_i$

5. What is the difference between the saturated and unsaturated zone?
- The saturated zone has a higher porosity than the unsaturated zone.
 - The saturated zone has a lower porosity than the unsaturated zone.
 - The pore spaces in the saturated zone are completely full of water; the pore spaces in the unsaturated zone are not completely full of water.
 - The pore spaces in the saturated zone are not completely full of water; the pore spaces in the unsaturated zone are completely full of water.
 - The saturated zone has a higher permeability than the unsaturated zone.

SECTION B

(Short answers 5 marks each - spend up to 15 minutes)

- What is the difference between hydraulic conductivity and intrinsic permeability?
- Explain the difference between the release of water from storage in a confined and unconfined (water-table) aquifer?
- What features distinguish a recharge slough from a discharge slough?
- Why might seismicity be increased by the filling of a large surface water impoundment?
- The graphs represent the response of two aquifers (A and B) to pumping at a constant rate.

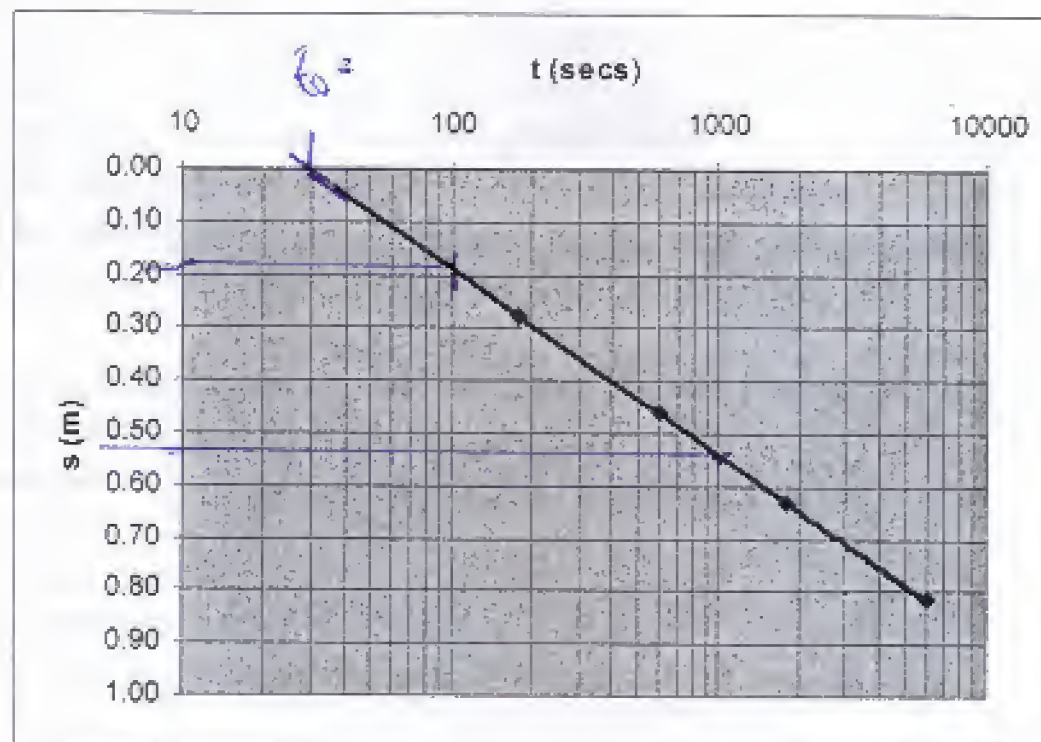


What kinds of boundary condition are indicated by the response of the two aquifers?

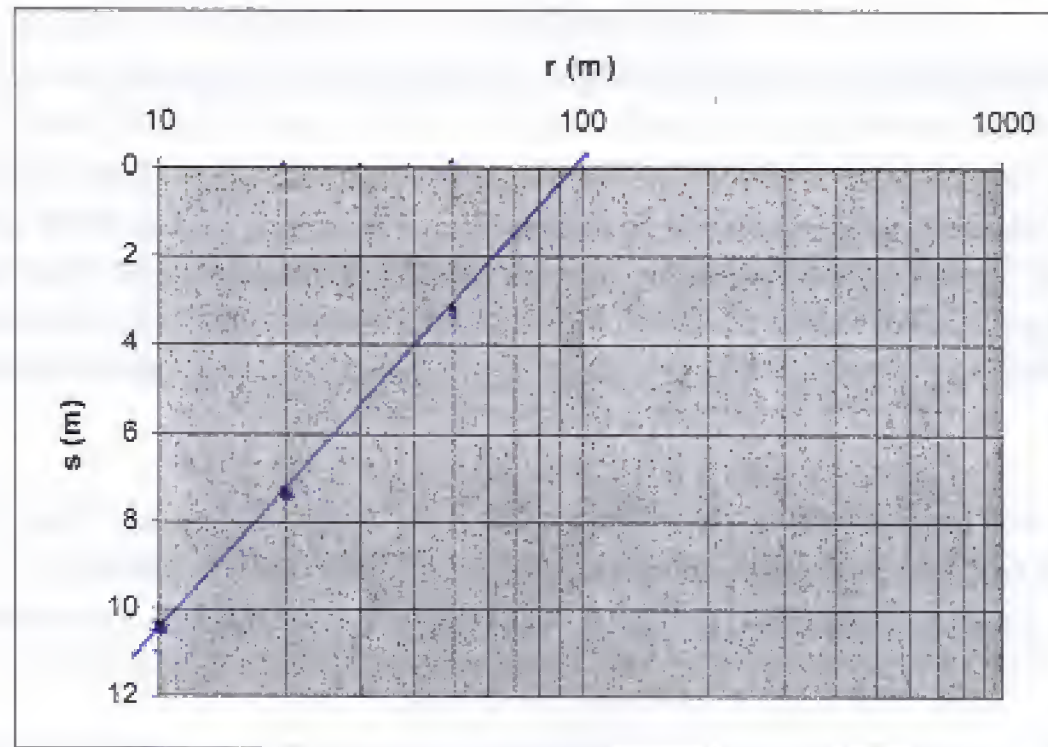
SECTION C

(Calculations 10 marks each - spend up to 35 minutes)

- ✓ 11. An unconfined fresh water aquifer [the density of water can be assumed to be $1,000 \text{ kg/m}^3$] has a thickness of 23 m at the location of a piezometer installed to a total depth of 16 m. The land surface elevation at the piezometer is 98 m above sea level, and the measured depth to the water table is 6.5 m below the ground surface. What is the total hydraulic head for the aquifer? What is the pressure head and elevation head at the base of the aquifer?
- ✓ 12. Measurements of drawdowns at two wells were 2.27 m and 0.8 m at radial distances of 10 and 1000 m respectively from a pumped well that has been supplying 2 L/s for several years. Use the Thiem equation [$s = (Q/2\pi T)\ln(r/R)$] to estimate the transmissivity of the aquifer.
- ✓ 13. A circular section of tunnel radius 3.0 m with a length of 200 m allows water to freely flow into the Partagas Pond Protoactinium Mine. Assuming a unit hydraulic gradient and a reasonable value for hydraulic conductivity, estimate the inflow from the sandstone bedrock.
14. The graph shows the $\ln(\text{time})$ vs drawdown response for an aquifer pumped at a rate of 1.16 L/s. Use the Cooper-Jacob equation [$s = (Q/4\pi T)\ln(2.25Tt/r^2S)$] to estimate the aquifer transmissivity (T) and storage coefficient (S). Is the aquifer confined or unconfined? $r = 20 \text{ m}$



15. After a well has been pumping for 60 days at a constant rate, three observation wells at radial distances of 10, 20 and 50 m show relatively constant drawdowns of 10.52, 7.51 and 3.53 m respectively. Estimate the radius of influence of the pumped well. Do you think the aquifer confined or unconfined? Justify your answer?



16. Complete the following table in your answer book using an appropriate number of significant digits:

	Hydraulic Conductivity (m/s)	Porosity (%)	Specific Yield (%)
Sand			
Silt			
Clay			
Granite			

THE END